Claims

[c1]   A method for defect inspection of microfabricated structures having repetitive and non-repetitive regions, the method comprising:

a. determining a contrast threshold;

b. acquiring contrast data from the microfabricated structures;

c. thresholding the contrast data with the contrast threshold to create a mask of non-repetitive regions of the contrast data;

d. masking the contrast data with the mask to create masked regions and unmasked regions of the contrast data; and

e. comparing the unmasked regions of the contrast data with reference data to detect defects in the repetitive regions of the microfabricated structures and to create defect data.

[c2]   The method of claim 1, wherein the microfabricated structures are on a semiconductor wafer.

[c3]   The method of claim 1, wherein the acquiring contrast data step is performed with an e-beam inspection system.

[c4]   The method of claim 1, further comprising reporting the defect data.

[c5]   A method for detecting defects in microfabricated structures having repetitive and non-repetitive regions, the method comprising:

a. acquiring contrast data from the microfabricated structures;

b. analyzing automatically the contrast data to find repetitive regions of the contrast data; and

c. comparing the repetitive regions of the contrast data with reference data to detect defects in the microfabricated structures.

[c6]   The method of claim 5, wherein the reference data are repetitive cells in the repetitive regions.

[c7]   The method of claim 5 further comprising finding non-repetitive regions in the contrast data and comparing the non-repetitive regions of the contrast data with non-repetitive reference data.

[c8] The method of claim 5, wherein the analyzing step includes using a cell-metric to find the repetitive regions of the contrast data.

[c9] The method of claim 5, wherein the analyzing step includes using at least one of an X and Y cell size to find the repetitive regions of the contrast data.

[c10] The method of claim 5, wherein the analyzing step includes using at least one of a cell repetition spatial frequency and a harmonic of a cell repetition spatial frequency to find repetitive regions of the contrast data.

[c11] The method of claim 5, wherein the analyzing step includes using a range of the contrast data to find the repetitive regions of the contrast data.

[c12] The method of claim 5, wherein the analyzing step includes using a range of the contrast data calculated over a window to find the repetitive regions of the contrast data.

[c13] The method of claim 5, wherein the analyzing step includes using a range of the contrast data calculated over a cell-sized window to find the repetitive regions of the contrast data.

[c14] The method of claim 5, wherein the analyzing step includes using a cell template to find the repetitive regions of the contrast data.

[c15] The method of claim 5, wherein the analyzing step includes creating at least one profile of a cell-metric of the contrast data and thresholding the profile to find repetitive regions in the contrast data.

[c16] The method of claim 5, wherein the analyzing step includes creating at least one X-direction one-dimensional profile of a cell-metric of the contrast data and at least one Y-direction one-dimensional profile of the cell-metric of the contrast data and thresholding the at least one X-direction one-dimensional profile and the at least one Y-direction one-dimensional profile to find the repetitive regions in the contrast data.

[c17] The method of claim 5, wherein the analyzing step includes creating at least two X-direction one-dimensional profiles of a cell-metric of the contrast data and at least

two Y-direction one-dimensional profiles of the cell-metric of the contrast data and thresholding the two X-direction one-dimensional profiles and the two or more Y-direction one-dimensional profile to find the repetitive regions in the contrast data.

[c18]   The method of claim 5, wherein the acquiring contrast data step is performed with an e-beam inspection system.

[c19]   The method of claim 5 that further comprises reporting defect data of detected defects.

[c20]   The method of claim 5, wherein the microfabricated structures are on a semiconductor wafer.

[c21]   The method of claim 5, wherein the comparing step further comprises arbitration comparison of the contrast data with at least two reference data sets.

[c22]   The method of claim 5, wherein the acquiring step comprises acquiring contrast data with an integer number of pixels across a single repeated cell of the microfabricated structure.

[c23]   A method for defect inspection of semiconductor wafers having repetitive and non-repetitive regions, the method comprising:
a. acquiring contrast data from the semiconductor wafer with an e-beam defect inspection system;
b. analyzing the contrast data using a range of the contrast data to find repetitive regions of the contrast data;
c. comparing the repetitive regions of the contrast data with reference data to detect defects and find locations of the defects in the semiconductor wafer; and
d. reporting the locations of the defects.

[c24]

A defect inspection system for detecting defects in microfabricated structures having repetitive and non-repetitive regions, the system comprising:
- an XY stage disposed to support the microfabricated structures for inspection;
- a microscope and detector to acquire contrast data of the microfabricated structures;

– an image computer equipped with stored program instructions for processing the contrast data to detect defects in the microfabricated structures, the processing comprising analyzing automatically the contrast data to find repetitive regions of the contrast data and comparing the repetitive regions with repetitive reference data to the detect defects in the microfabricated structures.

[c25]   The defect inspection system of claim 24 wherein the microscope is an e-beam-based microscope.

[c26]   The defect inspection system of claim 24 wherein the reference data are repetitive cells in the repetitive regions.

[c27]   The defect inspection system of claim 24 wherein analyzing automatically the contrast data comprises using a cell-metric to find the repetitive regions of the contrast data.

[c28]   The defect inspection system of claim 24 wherein analyzing automatically the contrast data comprises using at least one of an X and Y cell size to find repetitive regions of the contrast data.

[c29]   The defect inspection system of claim 24 wherein analyzing automatically the contrast data comprises using a range of the contrast data to find the repetitive regions of the contrast data.

[c30]   The defect inspection system of claim 24 wherein analyzing automatically the contrast data comprises creating at least one profile of a cell-metric of the contrast data to find repetitive regions of the contrast data.

[c31]   The defect inspection system of claim 24 wherein the microscope is an optical microscope.

[c32]   The defect inspection system of claim 24 wherein the microfabricated structures are on a semiconductor wafer.

[c33]   The defect inspection system of claim 24 wherein a magnification of the microscope is set to ensure an integer number of pixels of the contrast data across a single repeated cell of the microfabricated structures.

[c34]   The defect inspection system of claim 24 wherein the processing further comprises analyzing automatically the contrast data to find non-repetitive regions of the contrast data and comparing the non-repetitive regions with non-repetitive reference data to the detect defects in the microfabricated structures.

[c35]   The defect inspection system of claim 24 wherein detected defects are reported.

[c36]   A defect inspection system for detecting defects in microfabricated structures having repetitive and non-repetitive regions, the system comprising:
- XY stage means disposed to support the microfabricated structures for inspection;
- microscope means and detector means to acquire contrast data of the microfabricated structures;
- means for processing the contrast data to detect defects in the microfabricated structures, the means for processing comprising means for analyzing the contrast data to find repetitive regions of the contrast data and means for comparing the repetitive regions with repetitive reference data to the detect defects in the microfabricated structures.

[c37]   The defect inspection system of claim 36 wherein the microscope means is an e-beam-based microscope.

[c38]   The defect inspection system of claim 36 wherein the reference data are repetitive cells in the repetitive regions.

[c39]   The defect inspection system of claim 36 wherein means for analyzing the contrast data comprises using a cell-metric to find the repetitive regions of the contrast data.

[c40]   The defect inspection system of claim 36 wherein the means for analyzing automatically the contrast data comprises using at least one of an X and Y cell size to find repetitive regions of the contrast data.

[c41]   The defect inspection system of claim 36 wherein the means for analyzing the contrast data comprises means for using a range of the contrast data to find the repetitive regions of the contrast data.

[c42]   The defect inspection system of claim 36 wherein the means for analyzing the contrast data comprises means for creating at least one profile of a cell-metric of the contrast data to find repetitive regions of the contrast data.

[c43]   The defect inspection system of claim 36 wherein the microscope means is an optical microscope.

[c44]   The defect inspection system of claim 36 wherein the microfabricated structures are on a semiconductor wafer.

[c45]   The defect inspection system of claim 36 wherein a magnification of the microscope means is set to ensure an integer number of pixels of the contrast data across a single repeated cell of the microfabricated structures.

[c46]   The defect inspection system of claim 36 wherein processing means further comprises means for analyzing the contrast data to find non-repetitive regions of the contrast data and means for comparing the non-repetitive regions with non-repetitive reference data to the detect defects in the microfabricated structures.

[c47]   The defect inspection system of claim 36 wherein detected defects are reported.